Post-Conference Activities

No Remote Control?

Teacher Sheet(s)

Objective: To demonstrate that radio waves cannot pass through certain materials.

Level: 5-8
Subjects(s): Science
Prep Time: Less than 10 minutes
Duration: 30 - 45 minutes
Materials Category: Common Household

National Education Standards
Science: Unifying Concepts, Science as Inquiry, Physical Science, Technology, History and Nature of Science

Materials:

- Television with remote control
- Tape
- Scissors
- Aluminum foil
- Yarn (6 feet long), any color
- Student Sheets

Pre-Lesson Instructions:
This lesson requires a television set with a remote control. Have extra batteries for the remote control on hand in case the batteries run out of power.
Students may want to work in pairs or small groups for the activity involved in this lesson.

Background Information:
The Space Amateur Radio Experiment (SAREX) has been included on many Shuttle flights and will be on the International Space Station. In order for SAREX to be operational, a signal must connect a radio on Earth to the Shuttle orbiter or International Space Station. The signal cannot be seen by the human eye, but must be present for an astronaut or a student to talk or to be heard. This signal is called a radio wave. Radio waves are a form of energy. They go from the radio on Earth to a land-based antenna. The signal is then transmitted to an antenna located in the window of the orbiter, then to the SAREX system inside the orbiter. This process is reversed as the signal is sent back to Earth. Many school children over the years

have been able to participate in or listen to conversations to and from space using this system.

Another important use for radio waves is to send signals to distant exploration space probes. These signals are sent and received by the Deep Space Network (DSN). The DSN is the system that NASA uses to communicate with its many spacecraft exploring other worlds. It is the largest and most sensitive scientific telecommunications system in the world. The DSN is a collection of three communications complexes that support interplanetary spacecraft missions. Each complex has several antennas with diameters ranging in size from 26 meters (85 feet) to 70 meters (230 feet). One of the complexes is at Goldstone in California's Mojave Desert; another is near Madrid, Spain; and the third is near Canberra, Australia. This placement puts the three facilities about 120 degrees around the world from each other, allowing constant contact with spacecraft as the Earth rotates. The antennas can be steered toward a particular direction with very high accuracy. The two-way communications system between the ground and the spacecraft makes it possible to receive telemetry data from spacecraft and determine their position and velocity and to transmit commands back to the spacecraft. The DSN is operated by NASA's Jet Propulsion Laboratory, which also operates many of the agency's interplanetary spacecraft missions.

This activity involves the entire class. A television will be used since it is an item readily accessible in most schools. Most television remote controls use infrared signals. In this activity, the signal will be blocked by aluminum foil, a very light, man-made metal. Students will then have the opportunity to experiment with different materials to see how they affect the radio signal.

Guidelines:

1. Point out the television and remote control to the students. Ask students what the function of the remote control is. Students list individual observations of the properties of the remote control on the Student Sheet.

2. Take examples of student observations from volunteers, and place them on the board.

3. Ask a student to turn on the television. List individual predictions on Student Sheet on the board as to what will happen when another student points the remote control at the television and pushes the channel button. Let a student demonstrate by changing channels.

4. Ask what the students think caused the remote control to turn on the television. Guide them to understand that the television receiving eye received the signal that caused the channel to change. Ask two students to take the yarn and show the path the signals took. Have them hold the yarn in place. (Guide them to the receiving eye on the television, not the screen.) Ask the class for the definition of a receiving eye. Check the list of

observations made on the Student Sheet and the board. If the term receiving eye is not there, add it to the list.

5. Ask a student to tape a piece of aluminum foil over the receiving eye on the television. Have students write predictions on the Student Sheet as to what will happen when a student tries to change the channel again. Elicit responses. NOTE: Aluminum is a very lightweight, nonmagnetic metal. The signal sent out from the remote control device is reflected by this metal.

6. Have a student try to change channels. Discuss what has happened. Ask the two students with the yarn if they can show the path the signal took this time. Lead them to stretch the yarn from the remote to the receiving eye and back out again showing the signal did not get through, but was reflected instead.

Discussion/Wrap-up:

- Have students write their observations of what has happened on the Student Sheet. Ask for volunteers to read their responses to the class. Discuss the observations.
- Repeat the activity using other materials from around the classroom in place of the aluminum foil. This could include wax paper, notebook paper, cardboard, wood, rubber, etc. Have students make predictions prior to the testing with the remote control.
- Collect Student Sheets for assessment.

Extensions:

- Have the students use remote-controlled cars or two-way radios to show the presence of radio waves. Experiment with the different variables such as the distance the waves travel. How far away can the car be controlled? How far away can you hear another person?
- Have students try pointing the remote control at different angles from the television. Does the control need to be pointed at the television? What happens when it is pointed in another direction?

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Student Sheet(s)

Name: _____

List observations of television	List observations of remote control
Predictions	
Predictions for aluminum foil	What have you learned?

Resources

NASA
For information on exploratory missions, manned spaceflight, and more, please visit this website.
www.nasa.gov

NASA Kids
For activities, games, stories and more, visit this website specifically designed for kids that are interested in space and NASA.
http://www.nasa.gov/audience/forkids/home/index.html

American Radio Relay League (ARRL)
http://www.arrl.org

Radio Amateur Satellite Corporation (AMSAT)
http://www.amsat.org